EXHIBIT 1

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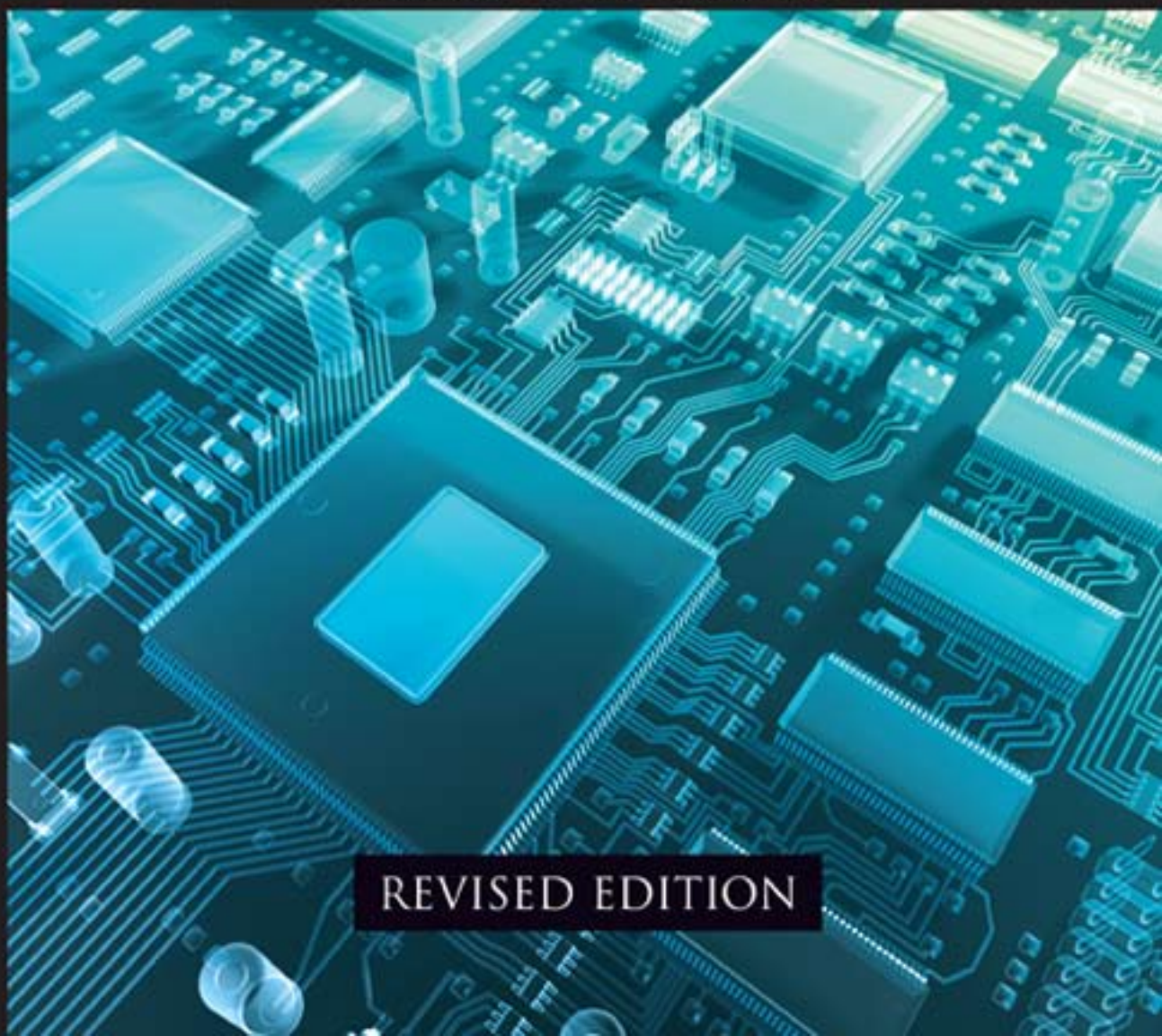
ENCYCLOPEDIA OF COMPUTER SCIENCE AND TECHNOLOGY

HARRY HENDERSON



REVISED EDITION

In memory of my brother,
Bruce Henderson,
who gave me my first opportunity to explore
personal computing almost 30 years ago.

ENCYCLOPEDIA OF COMPUTER SCIENCE AND TECHNOLOGY, Revised Edition

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Facts On File, Inc.
An imprint of Infobase Publishing
132 West 31st Street
New York NY 10001

Library of Congress Cataloging-in-Publication Data

Henderson, Harry, 1951–
Encyclopedia of computer science and technology / Harry Henderson.—Rev. ed.
p. cm.
Includes bibliographical references and index.
ISBN-13: 978-0-8160-6382-6
ISBN-10: 0-8160-6382-6
1. Computer science—Encyclopedias. 2. Computers—Encyclopedias. I. Title.
QA76.15.H43 2008
004.03—dc22 2008029156

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Text design by Erika K. Arroyo
Cover design by Salvatore Luongo
lllustrations by Sholto Ainslie
Photo research by Tobi Zausner, Ph.D.

Printed in the United States of America

VB Hermitage 10 9 8 7 6 5 4 3 2 1

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a varying level of current (see SCANNER). This analog signal is in turn converted into a digital reading by an analog-to-digital converter, which creates numeric information that represents discrete spots (pixels) representing either levels of gray or of particular colors. This information is then written to disk using the formats supported by the operating system and the software that will manipulate them.

Further Reading

Chalmers, David J. "Analog vs. Digital Computation." Available online. URL: http://www.u.arizona.edu/~chalmers/notes/analog.html. Accessed April 10, 2007.

Hoeschele, David F. *Analog-to-Digital and Digital-to-Analog Conversion Techniques*. 2nd ed. New York: Wiley-Interscience, 1994.

analog computer

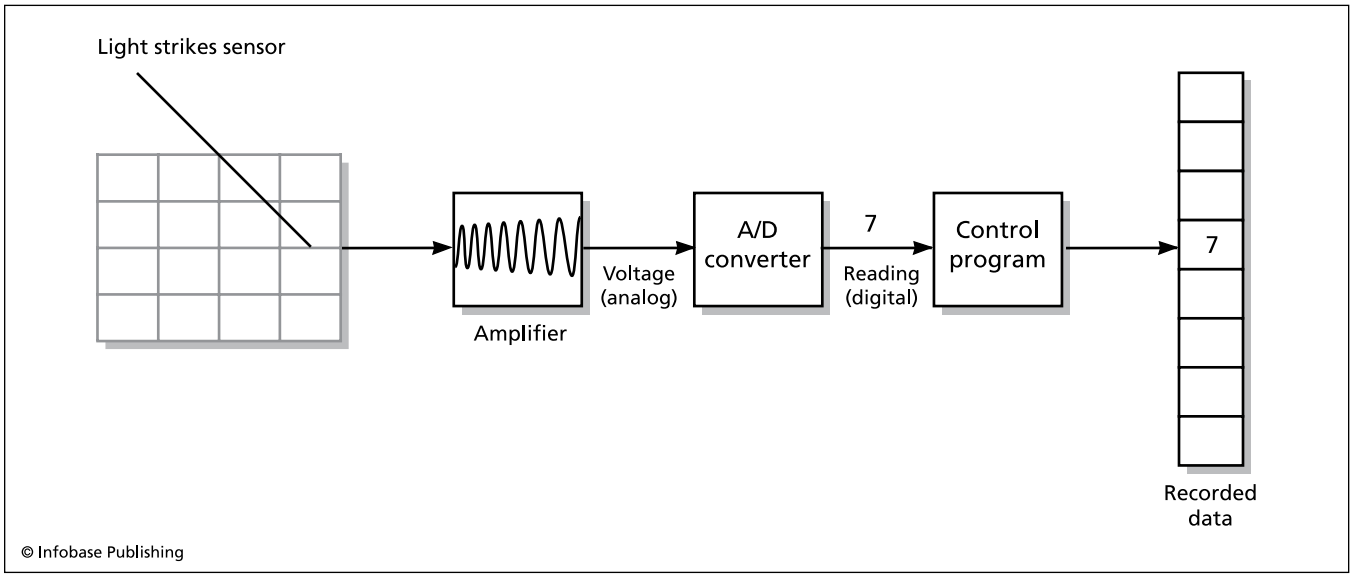
Most natural phenomena are analog rather than digital in nature (see ANALOG AND DIGITAL). But just as mathematical laws can describe relationships in nature, these relationships in turn can be used to construct a model in which natural forces generate mathematical solutions. This is the key insight that leads to the analog computer.

The simplest analog computers use physical components that model geometric ratios. The earliest known analog computing device is the Antikythera Mechanism. Constructed by an unknown scientist on the island of Rhodes around 87 B.C., this device used a precisely crafted differential gear mechanism to mechanically calculate the interval between new moons (the synodic month). (Interestingly, the differential gear would not be rediscovered until 1877.)

Another analog computer, the slide rule, became the constant companion of scientists, engineers, and students until it was replaced by electronic calculators in the 1970s. Invented in simple form in the 17th century, the slide rule's movable parts are marked in logarithmic proportions, allowing for quick multiplication, division, the extraction of square roots, and sometimes the calculation of trigonometric functions.

The next insight involved building analog devices that set up dynamic relationships between mechanical movements. In the late 19th century two British scientists, James Thomson and his brother Sir William Thomson (later Lord Kelvin) developed the mechanical integrator, a device that could solve differential equations. An important new principle used in this device is the closed feedback loop, where the output of the integrator is fed back as a new set of inputs. This allowed for the gradual summation or integration of an equation's variables. In 1931, VANNEVAR BUSH completed a more complex machine that he called a "differential analyzer." Consisting of six mechanical integrators using specially shaped wheels, disks, and servomechanisms, the differential analyzer could solve equations in up to six independent variables. As the usefulness and applicability of the device became known, it was quickly replicated in various forms in scientific, engineering, and military institutions.

These early forms of analog computer are based on fixed geometrical ratios. However, most phenomena that scientists and engineers are concerned with, such as aerodynamics, fluid dynamics, or the flow of electrons in a circuit, involve a mathematical relationship between forces where the output changes smoothly as the inputs are changed. The "dynamic" analog computer of the mid-20th century took advantage of such force relationships to construct devices where input forces represent variables in the equation, and



Converting analog data to digital involves several steps. A sensor (such as the CCD, or charge-coupled device in a digital camera) creates a varying electrical current. An amplifier can strengthen this signal to make it easier to process, and filters can eliminate spurious spikes or "noise." The "conditioned" signal is then fed to the analog-to-digital (A/D) converter, which produces numeric data that is usually stored in a memory buffer from which it can be processed and stored by the controlling program.